Muffler

Description

The invention relates to a muffler which is intended in particular also for internal combustion engines, having a housing through which a gaseous medium flows and which has at least one housing chamber and in which deflecting elements serving to make the gaseous medium swirl are arranged one behind another along an axis of the housing and in a positionally fixed manner at a distance from one another.

Mufflers of this type are disclosed, for example, in DE 848 877 and in DE 197 56 468 C1. In the first-mentioned case, locking plates serving as deflecting elements are provided and are inserted into the housing in such a manner that they form labyrinth-like flow paths for the gases without making metallic contact with the housing wall. Furthermore, a muffling material is provided and lines the inner wall of the housing in the form of a lining pad.

In the case of DE 197 56 468, disks which are similar to fan wheels are arranged in a positionally fixed manner in the housing in order to cause swirling of the gaseous medium. Disk-like insulating segments composed of sound-absorbing material are fitted in each case between two successive disks and have free passage openings.

Furthermore, mufflers are known in which the flow of exhaust gas - in the case of internal combustion engines - is broken up by means of a complex arrangement of pipes and/or perforated intermediate walls and/or damping wool and, if appropriate, by means of additional rear mufflers and the noise produced by the emerging exhaust gas is thereby reduced. It is not possible for these damping systems to be completely satisfactory in respect of the damping action and/or the complexity and/or the adaptability to the particular application.

Accordingly, the invention is based on the object of providing a muffler which is of particularly simple construction and, firstly, consists of simply designed elements and, secondly, is particularly effective and flexible, with the result that it can also easily be adapted to different operating conditions.

To achieve this object, the invention makes provision, by means of the features of the defining part of patent claim 1, for a disk-shaped body having slots to be provided in each case as deflecting element and to extend over the cross section of the housing chamber, and for guiding elements which bound the slots, are in the manner of guide vanes and belong to adjacent, disk-shaped bodies to deflect the flow in different directions with respect to the main axis of the housing.

A muffler of this type manages without the use of sound-absorbing material. Neither lining pads on the inner walls of the housing nor insulating elements consisting of sound-absorbing material between the deflecting elements are required. Just deflecting the flow with the aid of the guiding elements in th manner of guide vanes causes sound to be absorbed, in which case sound vibrations cancel one another out. This is

achieved especially by different setting angles, in particular if the guiding elements of adjacent, disk-shaped bodies are in each case preferably angled in an opposite direction to one another.

According to the invention, deviations and deflections and also swirling of the gas flow therefore take place in the present case in such a manner that good muffling is produced.

At the same time, the muffler is of simple and compact construction especially when disk-shaped bodies in the form of circular rings in an axial arrangement one behind another are used.

Furthermore, the muffling effect can be adapted without any problem to the particular requirements, for which purpose the number of slotted deflecting elements and/or the number of guiding elements in the form of guide vanes per deflecting element and/or the shape and design of the guiding elements and/or the setting angles of the guiding elements and/or the orientation of the setting angle between adjacent deflecting elements can be changed. This permits specific adaptation to each application or to different engines in a simple manner.

The invention will be explained in greater detail below with reference to exemplary embodiments which are illustrated in the drawing, in which, in each case schematically:

fig. 1 shows a muffler in section;
fig. 2 shows a different view of the muffler according to fig. 1 with the housing partially broken away and in a simplified illustration;
fig. 3 shows a perspective illustration on an enlarged scale of a modified muffler with th housing indicated by dashed lines and with five disk-

shaped deflecting elements which are illustrated pulled apart in an exploded manner and have guiding elements;

fig. 4 shows an illustration corresponding to fig. 3, again on an enlarged scale, with deflecting elements in the operating position with five stages or deflecting elements and with some of them at a different axial distance from one another, and

fig. 5 shows, partially cut away, a muffler which has been slightly modified in comparison to fig. 1 and has an alternative throughflow direction.

A muffler 1 comprises a housing 2 having at least one housing part or a housing chamber. The housing 2 is formed by a pot-shaped head element 3, which serves as the housing chamber and has a front end wall 4, and by a cup-shaped housing part 5, which likewise serves as the housing chamber. The housing 2 furthermore has a cylindrical circumferential wall 6 and an end wall 7 at its one end.

According to the exemplary embodiments illustrated in figs. 1 and 2, a fastening edge 8 having a slightly larger diameter and having fastening holes 9 distributed in the circumferential direction is situated on the head element 3. The housing part 5 is pushed with its open end under the fastening edge 8 of the head element 3 until it makes contact. In the fitted position, the head element 3 and the housing part 5 are connected fixedly to each other. For this purpose, fastening means 10 which extend through the fastening holes 9 are provided. Screw bolts or else rivets are suitable as fastening means 10.

According to the exemplary embodiment, a supporting pipe 11 having a circular cross section extends along an axis of the housing through the end wall 4 at the head end and through the head element 3. The supporting

pipe 11 protrudes with its one end outward through the end wall 4 where it forms an inlet stub, while its other, likewise open end ends inside the housing 2 at a distance from the end wall 7 (fig. 1).

In the operating state, the gaseous medium/exhaust gas flows through the supporting pipe 11 into the housing 2 and emerges from the housing 2 through an outlet stub/outflow stub 12. This outflow stub 12 can be fastened to the head element 3 in a radial arrangement and can be open outward and toward the interior of the housing 2.

According to the exemplary embodiments illustrated in figs 1 and 2, and 5, four deflecting elements 13, 14, 15 and 16 in the manner of impellers are provided as sound-absorbing or swirling elements. According to the exemplary embodiment, said deflecting elements can be pushed in each case by means of a bushing-shaped or annular hub part 17 onto the supporting pipe 11. They are arranged in a rotationally fixed or positionally fixed manner on the supporting pipe 11, it being possible for this to be achieved by a positive or non-positive connection between the hub parts 17 and the supporting pipe 11 or else by a separate locking means.

Each deflecting element 13 to 16 in the manner of an impeller forms a muffler stage and has a plurality of guiding elements 18 in the manner of impellers or guide vanes. According to the exemplary embodiments illustrated in figs 1 to 5, the deflecting elements 13 to 16' are in each case disk-shaped and slotted bodies 17' with in each case approximately 20 guiding elements 18 in the manner of guide vanes. The deflecting elements 13 and the disk-shaped slotted bodies 17' are expediently integral in each case with their guiding elements in the manner of guide vanes. They extend in the housing 2 as far as the cylindrical circumferential wall 6.

The guiding elements 18 of each deflecting element 13 to 16 are inclined or angled at a uniform setting angle α of, for example, 15° (preferably between ° and °) with respect to the respectively associated radial planes 19. The setting angles α of respectively adjacent deflecting elements are expediently set positively or negatively, as emerges from fig. 2. A flow which is originally essentially directed axially is therefore correspondingly deflected in each case.

In the starting state, the disk-shaped bodies 17' are flat sheet-metal rings and, as disk blank, obtain narrow slots 18' which extend radially and rectilinearly from the outside to the inside. Owing to the slots 18' and owing to the circular-ring shape of the disk-shaped bodies 17', the guiding elements 18 are in each case in the form of a sector of a circular ring. The positive and/or negative setting angles of the guiding elements mean that there are slot-shaped passage openings in each deflecting element with the effect of enabling the gaseous medium to flow through the deflecting elements 13 to 16 in the longitudinal direction of the housing 2 irrespective of the respective deviations.

The illustrations in the figures show that the housing 2 of the muffler 1 does not have to be completely occupied with deflecting elements having guiding elements 18 corresponding to the elements 13 to 16. Although the deflecting elements 13 to 16, 16' are arranged one behind another along the main axis 19' of the housing and in a positionally fixed manner at a distance from one another in order to make the flow medium swirl, the housing 2 nevertheless preferably has a completely unoccupied housing chamber part 2'. The housing chamber part 2' serves as a calming section.

In figs 1 and 2, a comparatively short supporting pipe 11 (for four deflecting elements 13 to 16) is provided in conjunction with a comparatively long housing part 5 which could accommodate double or even triple the number of deflecting elements. It may therefore be expedient, in order to utilize the possibilities arising from the compact construction in conjunction with the variation in the number of deflecting elements, to provide for the head element 3 different housing parts 2 and supporting pipes 11 having a graduated length which are then assembled as a function of the particular application.

Likewise, deflecting elements having guiding elements which differ in terms of their number, their shape and their setting angle, may also be provided for selection to adapt them to the application conditions.

Whereas the direction of flow of the gaseous medium in the case of the muffler 1, which is illustrated in fig. 1 as an exemplary embodiment, is directed from the outer opening of the supporting pipe 11 into the interior of the cup-shaped housing part 5 and the gas then flows through the deflecting elements of the various stages to the outflow stub 12, in the case of the exemplary embodiment illustrated in fig. 5, an inlet stub 20 is situated at the one end 21 of the cup-shaped housing part 5 while an outlet stub 22 is arranged coaxially at the other end 23 of the cup-shaped housing part 5 - or, conversely, on its pot-shaped head element 3. An outflow stub 12 branching off at right angles as in the case of the exemplary embodiment illustrated in fig. 1 is therefore not absolutely necessary.

Also, the function of the supporting pipe 11, which serves at the same time as an inlet stub, in the exemplary embodiment according to fig. 1 is omitted in the case of the muffler according to fig. 5, since

there a centrally arranged support or a supporting element 24 serves exclusively for supporting and/or connecting the muffler stages 25 comprising deflecting elements 13 to 16.

According to the exemplary embodiments illustrated in figs 1 and 5, four or five muffler stages 25 are provided in each case. However, more or fewer muffler stages 25 may also be arranged along the central supporting element 24 in accordance with the particular conditions.

In addition, it is highly essential for the muffler according to the invention also to have only a very low flow resistance in comparison to conventional mufflers.

In principle, the deflecting elements may consist of metal and may have solid or permeable guiding elements, for example in the form of a fine-meshed ribbed mesh. Furthermore, plastics or composite materials are also suitable materials.

Finally, the deflecting elements 13 to 16' also prevent a back-surge in the muffler 1, which has a thermally favorable effect in the case of an internal combustion engine.

Also, the variable arrangement and the variable number of deflecting elements in conjunction with variable setting angles in a wide range of positive and negative sizes of angle also enable certain frequencies to be filtered out or intended vibrations to be produced. In terms of the valuable damping properties, the muffler is of comparatively simple and compact construction.

Furthermore, it is characteristic for those ends of the guiding elements 18 which are arranged at a distance from the main axis 19' of the housing to be angled more sharply than their ends which are situated near the

main axis 19' of the housing and for the guiding elements 18 to be able to be at least partially twisted in themselves.

The invention is not restricted to the exemplary embodiments specifically illustrated in the figures; on the contrary, numerous modifications are possible without deviating from the basic concept of the invention.

The same also applies in principle to the manner in which the muffler is used with it not being restricted to certain internal combustion engines, but rather being able to be used very generally, this also applying in particular to its use for model aircraft and for engines having high speeds of rotation.

As emerges from the figures, the deflecting elements of the exemplary embodiments, which are in the manner of impellers, are preferably caused by production to have opposed, short slots 18'' directed in the circumferential direction in the base region of the guiding elements 18, which are in the manner of guide vanes. As a result, each guiding element 18 is connected to the hub part 17 by just a narrow web which cannot be seen in the figures. The effect achieved by this is that, if the need arises, each guiding element 18 in the manner of an impeller can be given a completely flat, sheet-like shape in spite of the setting angle α.

For strength reasons, after being slit in the circumferential region, the guiding elements 18 can additionally be soldered in the base region in a point-like manner to the hub part 17 and to the supporting pipe 11/to the supporting element 24.